

## ON SOME EXTINCT REPTILES AND BATRACHIA FROM THE JUDITH RIVER AND FOX HILLS BEDS OF MONTANA.

BY E. D. COPE.

## LÆLAPS, Cope.

Proceed. Acad., Phila., 1866, p. 275. Extinct Batr. Rept. N. Amer., 1869, p. 100.

Two species of this genus were described in the latter memoir above cited, the *L. aquilunguis*, Cope, and *L. macropus*, Cope, both from the greensand or Fox Hills group of the cretaceous of New Jersey. A considerable portion of the skeleton of the former was described, including the peculiarities of the ankle-joint, which led me to the conclusion, previously unsuspected by naturalists, that the *Dinosauria* present affinities to the eursorial birds. The teeth of this species were described and figured, but in the *L. macropus* they were, and still remain, unknown.

In a preliminary report on the extinct vertebrata obtained by the writer on the Upper Missouri the present year, three additional species were referred to this genus, viz.: the *Lælaps incrasatus*; *L. explanatus*, and *L. falcus*. Their characters were ascertained from teeth alone, so that their pertinence to the genus *Lælaps* is not fully assured. A fourth species of carnivorous dinosaurian was described under the name of *Aublysodon lateralis*.

One of the most valuable specimens obtained by my expedition of 1876, is the nearly entire left dentary bone of the *Lælaps incrasatus*, which exhibits the teeth of its two extremities. The different forms of the teeth of the carnivorous *Dinosauria* graduate into each other by such easy stages, as to have given rise to question in reference to their proper interpretation; whether they indicate different species or only different positions in the dental series. In describing the *Aublysodon horridus*, the first known of the species of the Judith River beds, Dr. Leidy expressed the suspicion that a certain form characterized the teeth in the position of incisors, another those in the position of canines, and another form the remainder of the series. The teeth of the last kind have the form of those of *Lælaps*; in others the posterior serrulate cutting edge is

latero-posterior, the posterior aspect being thickened, and either transverse or convex in section. In the supposed canines the anterior serrulate edge is wanting, or represented by a second posterior edge parallel with the original one, thus forming a compressed chair-shaped crown. Numerous specimens of all these forms were obtained by the expedition.

Examination of the dental series of the *Laelaps incrassatus* shows that the antero-posterior diameter of one or two teeth in the position of canine, becomes oblique in the curved long axis of the dentary bone. The transverse diameter is also greatly increased so as to equal or even exceed the antero-posterior; the serrate edges are opposite to each other. A tooth of this type was the first of this species which I observed, and the name has reference to its peculiar form. A tooth in the position of first or anterior incisor, differs in having the anterior serrate crest removed to the middle of the inner aspect of the apical portion of the crown, while the posterior edge retains its usual position. Further posterior transfer of the anterior cutting edge and a grooving of the posterior face, would produce a tooth of the form suspected by Leidy to be the canine of *Aublysodon horridus*, while the canine just described is different from any tooth referred by Leidy to the same species. But a large tooth found in immediate association with the jaw, but separated from it, has the posteriorly truncate form described by Leidy as typical, and is very probably the tooth of the maxillary bone, near the position of the superior canine of a mammal.

It may be observed in conclusion, that if the teeth suspected by Leidy to be canines of *Aublysodon horridus*, but which I suppose to be incisors, are really such, *Aublysodon* must be regarded as a genus distinct from *Laelaps*; while, on the other hand, should such determination prove to be inadmissible, and the two genera be the same, the name *Laelaps* must be preserved as the older; it was published in 1866, while *Aublysodon* bears date 1868.

In examining the very numerous teeth discovered by the expedition, I find four species in addition to those already named. A list of all the species is now given.

*Laelaps incrassatus*, Cope, Proceed. Acad. Nat. Sci. 1876, Oct.

The dentary bone of this species, above alluded to, is of compressed form, and becomes thin and plate-like in its posterior portion. The latter is excavated on the inner side, where it is proba-

bly applied to the opercular and surangular bones, if they exist, and a large foramen is continued from the concavity into the remaining part of the dentary, as a tubular canal. Above the foramen there originates a groove which runs parallel to the inner alveolar border to the posterior edge of the symphysis. The latter is short, and scarcely distinguished from the other surfaces; the attachment of the rami was evidently ligamentous and more or less movable. The anterior alveolar portion of the ramus is produced, so that the symphysis slopes backwards below. The inferior border of the dentary bone is gently concave behind its middle. It is throughout convex in the transverse direction.

The external alveolar wall is an inch higher than the internal. The inner portions of the septa are apparently subject to exfoliation and subdivision in connection with the renewal of the teeth as a groove which is continuous with the inner alveolar borders, cuts them off from the other interior surface of the dentary bone. The external face of the dentary is in general plane, but is variously excavated along its superior border. An inch below the latter there extends a series of large foramina, each one of which is situated opposite to an interalveolar septum. They are more numerous anteriorly, a foramen being opposite each alveolus as well, and each foramen is connected with the border by a shallow groove. Similar foramina extend down the outer side of the symphyseal border, and along the inferior border of the dentary for two-thirds of its length. The same proportion of the external face is obsoletely rugose through the presence of delicate lines of growth. Such lines extend on the lower part of the interior face obliquely upwards and backwards.

There are alveolæ for fifteen teeth in the dentary bone. Of these only the second, third, fourth, fifth, twelfth, and fifteenth contained teeth capable of functional use at the time the jaw was inclosed in the lacustrine mud. Successional teeth occupy the first, tenth, and twelfth, but no two teeth are in an identical stage of protrusion. The section of the crown from and including the fourth to the last is nearly equilaterally lenticular. Their surface is smooth.

<i>Measurements.</i>		M.
Length of entire dentary bone . . . . .		.525
Depth at posterior border of symphysis . . . . .		.110
“ “ last tooth . . . . .		.192
“ to internal groove . . . . .		.060
“ “ “ foramen . . . . .		.074
Length of crown of second tooth . . . . .		.029
Diameter of second tooth at base	{ antero-posterior . . . . .	.013
	{ transverse . . . . .	.018
Length of crown of twelfth tooth . . . . .		.043
Diameter at base of twelfth tooth	{ antero-posterior . . . . .	.025
	{ transverse . . . . .	.017
Length of crown of superior canine . . . . .		.062
Antero-posterior diameter of do. . . . .		.028

As compared with the *Lælops aquilunguis*, of which a portion of the dentary bone is known, this species differs in the greater diameter of its inferior border anteriorly, in the presence of the internal groove, in the greater elevation of the external alveolar wall, and, if the character be constant, in the greater robustness of the form of the dental crowns. The individual here described is rather larger than the type of *L. aquilunguis*, but it is probable that the species were not very different in dimensions.

***Lælops hazenianus*, sp. nov.**

Seven teeth from different localities present constant characters which readily distinguish them from all other species of the genus. Their size is less than those of the two species above mentioned, and is greater than in the species enumerated below.

The crowns are short and robust, and are abruptly terminated by the strong recurvature of the anterior cutting edge. The apex has, therefore, a more posterior direction than in the *L. incrassatus*, while the anterior cutting edge is shorter. The latter is shortened below also, not extending to the base of the enamel, but terminating in a short lateral curvature. At the base, therefore, the anterior border is rounded, while the posterior is acute. The denticulations are of medium size, measuring M. .00033.

<i>Measurements.</i>		M.
Length of crown . . . . .		.014
Diameter of crown	{ antero-posterior . . . . .	.011
	{ transverse . . . . .	.007

Both sides are convex, but not equally so, and the surface is smooth, and without facets.

This saurian is dedicated to General Hazen, now in command at Fort Buford, Dakota, as a token of respect for his qualities as a man and his services in the interest of science.

*Laelaps lævifrons*, sp. nov.

A tooth half the size of those referred to the *L. hazenianus*, and exceeding by a little the largest of those of *L. explanatus*, presents such characters as induce me to believe that it belongs to a species distinct from either. It is of the elongate acuminate form of some of those referred to the *L. incrassatus*, and both sides are convex, but not equally so. A shallowly concave plane occupies the middle of the more convex side. The posterior cutting edge is denticulate to the base, but the anterior, though of the same form as in the other species, and unworn, is absolutely smooth. In this respect it differs from the other species, excepting *L. falculus*. The denticulations are finer than those of any other species, measuring M. .00020; in *L. explanatus* they measure M. .00022.

		<i>Measurements.</i>	M.
Elevation of crown	.	.	.015
Diameter of crown	{	antero-posterior	.007
		transverse	.004

*Laelaps explanatus*, Cope, Proceedings Academy, October, 1876.

*Laelaps falculus*, Cope, loc. cit.

*Laelaps cristatus*, Cope, sp. nov.

Another small species well distinguished by the form and coarse denticulation of the teeth, approaching the genus *Troödon*.

The crowns of the teeth are short, stout, compressed, and curved. Both sides are convex, and neither is faceted. The denticles are large, those of the posterior cutting edge the largest, and measuring M. .0005. A characteristic feature is the full development of the denticulate anterior cutting edge of the crown. This extends to the base, becoming more prominent as it descends. Surface smooth.

		<i>Measurements.</i>	M.
Elevation of crown	.	.	.011
Diameter of crown	{	antero-posterior	.006
		transverse	.003

**ZAPSALIS**, Cope.

The teeth of this genus are intermediate in form between those of *Laelaps* and *Paronychodon*. They have one flat and one con-

vex side, whose junctions form the anterior and posterior edges of the crown, as in the latter genus; and like the latter, there is no anterior cutting edge, but instead, a solid angle. But the posterior edge is denticulate as in *Laelaps*, and the plicæ or keels of *Paronychodon* are here only recognizable in low angles. Some light may be cast on the affinities of the latter genus by the discovery of *Zapsalis*.

*Zapsalis abradens*, sp. nov.

This reptile was apparently about the size of the *Laelaps lævifrons*. The best preserved tooth is that of a probably adult animal, as it displays considerable attrition, especially on the flat side. Here three worn lines indicate the former existence of as many low longitudinal angles of the surface, of which the median is basal and short. The convex side exhibits four low angles of nearly equal length, all stopping short of the apex. The facets between them, excepting the anterior two, are slightly concave. The denticles are of moderate coarseness, measuring M. .00033.

<i>Measurements.</i>		M.
Elevation of crown . . . . .		.0120
Diameter of crown {	antero-posterior . . . . .	.0065
	transverse . . . . .	.0030

#### URONAUTES, Cope.

*Genus novum Sauropterygiarum.* Cervical vertebræ, like the dorsals and caudals, short and transverse, and distinct from each other. Neural arches and transverse processes coëssified at maturity. Transverse processes of the cervicals simple and depressed. Extremities plesiosauroïd.

This genus might be referred to *Polycotylus*, Cope, were it not for the distinctness and greater abbreviation of the cervical vertebræ. From *Cimoliasaurus*, Leidy, it differs in the coëssification of the caudal diapophyses and the much greater abbreviation of the cervical vertebræ. The centra are amphiplatyan in *Cimoliasaurus*, biconcave in *Uronautes*. From *Pliosaurus*, Owen, which resembles the present form in the shortness of the cervical vertebræ, the coëssified transverse processes of the cervicals separate it. The present is pre-eminently a short-necked genus of the order.

The remains on which it reposes are the cervical, dorsal, and caudal vertebræ, with portions of limb and rib bones.

*Uronautes cetiformis*, sp. nov.

The cervical vertebra of this species is of unusual form, being short and transverse, and not wider than deep. In *Polycotylus latipinnis* this vertebra is much wider than deep, and as long as wide. The neuropophyses are compressed so as to be antero-posterior, and they inclose a rather wide neural canal. The parapophyses are directed equally downwards and outwards, occupying the position of the angle of a subquadrate outline, since the sides are nearly vertical. The articular faces are slightly concave, and the centrum is perforated vertically by the usual two foramina.

A dorsal vertebra found in immediate proximity to the cervical just described is much like that of the *Polycotylus latipinnis*. That is, it is exceedingly short antero-posteriorly, and has concave articular faces, the concavity with flat fundus, and marked with a few obscure concentric grooves. The sides are also slightly concave, and are pierced with a foramen at the superior portion. The vertical foramina are also present. The neural arch is in this specimen separated from the centrum, not having become coössified. This circumstance might lead to a doubt as to the proper reference of the specimen to this animal, but such doubt has little foundation. In one of the caudal vertebrae one of the diapophyses is coössified, and the other is not. The suture of the surface thus exposed is of a very fine texture, and evidently not like that seen in the genera where it is to act as a permanent articulation. In the case of the dorsal vertebra, the suture for the neuropophysis has the same character. This vertebra is much larger than the cervical, but does not much exceed the proximal caudal in size; preserving the relations seen in the *Polycotylus latipinnis*. Adjoining the border of the fossa of the neuropophysis is a small parapophysial tuberosity.

A proximal caudal vertebra has a very small fore and aft diameter, and the vertical exceeds the transverse diameter. The diapophyses spring from the middle of the sides of the centrum, while the inferior face is separated from the inferior lateral faces by an obtuse longitudinal angle. In general, the form is that of a transverse hexagon. The chevron facets are very slightly developed. Another probably distal caudal vertebra considerably resembles that in the corresponding part of the skeleton of a cetacean. It is without neural arch, transverse, flat below, and



with the two lateral faces of unequal length, the superior being the longer. The vertical perforating foramina join at the neural canal, and there is a short subquadrate plane on each side of the latter. There are no indications of chevron facets. These vertebrae are different from any of those yet known in *Polycotylus*.

<i>Measurements.</i>		M.
Diameter of a cervical centrum	antero-posterior . . . . .	.016
	vertical . . . . .	.026
	transverse . . . . .	.029
Diameter of a dorsal	antero-posterior . . . . .	.030
	vertical . . . . .	.055
	transverse . . . . .	.056
Diameter of a proximal caudal	antero-posterior . . . . .	.022
	vertical . . . . .	.040
	transverse . . . . .	.062
Diameter of a distal caudal	antero-posterior . . . . .	.015
	vertical . . . . .	.017
	transverse . . . . .	.038
Diameter of neural canal of the proximal caudal above measured . . . . .		.012
Do. of diapophysis of do. at base . . . . .		.018

The distal end of a proximal limb bone is much like the corresponding part of *Polycotylus latipinnis*. It is relatively of large size, flat, and strongly convex at the extremity, which is not transversely truncate. A portion of another limb bone, perhaps belonging to the distal segment, is symmetrical. The shaft is broken off, and displays a large medullary cavity, with thin walls, which soon terminates towards the articular end, in a fundus with a fissure in the bottom. The proximal portion of a rib has a truncate head of an oval outline. The inferior border presents a low tuberosity, which may represent the capitulum.

<i>Measurements.</i>		M.
Width of distal end of proximal limb bone . . . . .		.109
Thickness of the same . . . . .		.032
Diameter of proximal end of a rib	longer . . . . .	.030
	shorter . . . . .	.028

The bones above described were found together by the writer, on a slope of the cream-colored soft sandstone, which lies above the black shales of Cretaceous No. 4, near Amell's Creek, Montana. I suppose the formation to be the No. 5, or Fox Hills group of Meek and Hayden. Near them were found shark's teeth



of the genera *Otodus* and *Lamna*, and a species of *Enchodus*. Above them I found lying loose a fragment of a *Baculites*.

#### CHAMPSOSAURUS, Cope.

*Genus novum.* Vertebrae of more than a hundred individuals referable to several species, which I obtained from the Judith River beds of the Upper Missouri region, present characters which demand the establishment of a new genus for their reception.

The characters presented by the vertebral column are the following: The ribs have a single head, which articulates with a prominent tuberculum, excepting those of the cervical vertebrae. On these there is a small capitular tubercle below the diapophysis. It commences very small, and inferior in position, being removed, in fact, but a short distance from the inferior middle line in the first vertebra in which it appears. It rises rapidly in the succeeding centra until it is merged in the tuberculum of the diapophysis. The latter projects from the neural arch, which is free from the centrum, but in none does the base of the diapophysis rise from a point above the floor of the neural canal. On the dorsals it is vertically compressed. One of the anterior cervicals, probably the axis, is obliquely truncated below its anterior articular face, for a free hypopophysis or *os odontoideum*. This vertebra has no parapophysis, and the articular faces for the neuropophysis are superior. The few vertebrae in each of several series, probably from the sacral region, are more depressed than the others, and the facets for the diapophyses present a greater antero-posterior extent, but none are coössified. The caudal vertebrae are distally quite compressed. In all, except the anterior ones, the neural arch is coössified with the centrum, and in such there are no diapophyses. In those with free neural arch, the facets for the neuropophyses turn down on the sides of the centrum.

The articular extremities of the centra are plane, those of the caudal series slightly concave. There are no hypopophyses behind the axis, excepting a longitudinal carina, which ceases to exist on the dorsal vertebrae. The zygapophyses are simple. The chevron bones are free.

The relations of the atlas and axis, though not fully elucidated by my specimens, are peculiar. The former has separate neuropophyses, which have nearly the shape of those of the Streptostyliciate *Reptilia*, resembling much those of the *Pythonomorpha*.

Although I procured numerous cervical vertebræ, there are but few which exhibit the antero-inferior facet for supposed hypapophysis, already described. The position of this vertebra was in front of the first cervical which displays a parapophysis, and is, on this account, likely to be the axis or the third cervical vertebra. It is the more probably the axis, as there is no other among the large number of vertebræ in my collection which can be referred to that position. Its anterior articular face is smooth and like the posterior, showing that the odontoid bone was not eoëssified with it. Now in the *Crocodylia* the odontoid bone is united with the anterior extremity of the axis by suture, which may become eoëssified with age, while the free hypapophysis is wanting. In the streptostylicæ orders the hypapophysis is present, and the odontoid is above it, but united to the axis by suture. On the other hand, in the *Rhynchocephalia*, the axis is eoëssified with both odontoid and hypapophysis, and a few succeeding vertebræ possess free hypapophyses. Thus it is possible that I am yet unacquainted with the axis of *Champsosaurus*.

One entire rib and the heads of several others are all that were obtained. The former is from the anterior part of the dorsal series, and is stout and short. The head is truncate and compressed, its articular face is contracted, forming a narrow figure eight. The shaft is obliquely flattened. The extremities are separated from the lateral surfaces by a narrow angle, as though capped with cartilage in life, as in the *Pythonomorpha*.

Bones of the extremities are very rare. One fragment resembles the proximal end of a crocodylian tibia, and another is like the distal half or more of the tibia of the same type.

There is considerable resemblance between the vertebræ of this genus and those of *Hyposaurus*, Ow., from Cretaceous No. 5, of New Jersey, but the relations of the axis and atlas in that genus are as in other *Crocodylia*, and not like those seen in *Champsosaurus*. The absence of sacrum precludes the possibility of regarding this form as dinosaurian. It rather seems to share some rhynchocephalian characters with general amphiplatyan crocodylian resemblances. The shortness and robustness of the thoracic ribs is a feature quite unique, and reminds one of the *Batrachia*. The teeth are unknown in their true relations, but there are several types in the collections which may be found to belong here. These are of the rhizodont character.

As a summary of the preceding, I propose to refer the genus *Champsosaurus* to the order *Rhynchocephalia*, provisionally. It differs very much from the typical genus of that order, *Sphenodon*, in the non-coössification of the sacral vertebrae, and non-union of the neural arches of the vertebrae with their centra, and the absence of the chordal perforation of the latter. It differs from the extinct genera *Clepsydrops* and *Cricotus*, Cope, in the last mentioned two characters. On these grounds it may constitute a distinct suborder, under the name of *Choristodera*.

It is possible that the tooth, which I referred to a new genus and species, under the name of *Paronychodon lacustris* (Proceedings Academy, 1876, October), may belong to one of those of the present genus. In that case the older generic name takes precedence of the later. I may add that some vertebrae of this genus have been figured and described by Dr. Leidy in the Transactions of the American Philos. Society, 1860, without name.

I recognize four species among the vertebrae, chiefly by characters observed in the cervical region. There is a great discrepancy of size among them, and the small ones may be immature.

*Champsosaurus profundus*, sp. nov.

This species is chiefly known from a series of vertebrae found together, and having every appearance of pertaining to the same animal. It consists of a cervical, three dorsal, and a sacral vertebrae. Other isolated vertebrae of several individuals present similar characters.

The primary feature is the great vertical diameter of the dorsal vertebrae as compared with the transverse measurement. This is occasioned by the great development of the inferior keel, to which the sides of the centrum converge, without concavity. In corresponding centra of the *C. annectens* the inferior face is merely angulate. Another character is the obliquity of the articular faces to a vertical plane drawn at right angles to the long axis of the centrum. This is most strongly marked on posterior dorsals, where the inferior keel is less prominent. The sacral vertebra has a depressed form.

An anterior caudal vertebra may belong to this or an undescribed species. It has rudiments only of the chevron-facets, and having a large neural arch, is doubtless from the anterior part of the series. It is more compressed than the corresponding one in *C.*

*annectens*, and has an acute inferior angle, which is wanting in the latter.

*Measurements.*

	No. 1.	M.
Diameter of cervical centrum	{ longitudinal . . . . .	.020
	{ vertical . . . . .	.020
	{ transverse . . . . .	.018
Diameter of anterior dorsal centrum	{ antero-posterior . . . . .	.020
	{ vertical . . . . .	.022
	{ transverse . . . . .	.019
No. 2.		
Diameter of posterior dorsal centrum	{ antero-posterior . . . . .	.023
	{ vertical . . . . .	.019
	{ transverse . . . . .	.019

*Champsosaurus annectens*, Cope, sp. nov.

The greater number of vertebræ obtained belong to this saurian, which may therefore be looked upon as the type of the genus.

The cervical which bears the hypapophysial facet presents a carina below, which is only prominent between the articular faces. One such cervical in the collection is rounded below, and may be anterior in the series, or may belong to another species. The inferior keel is strong on the other cervicals, but soon disappears on the anterior dorsals. The remaining centra are rounded below. The parapophyses where present are knob-like, and the corresponding part of the transverse process is similar in the anterior dorsal vertebræ. The base of the neural arch is nearer the anterior than the posterior articular face. These faces are nearly round in the anterior caudal centra, but soon become vertical ovals, with the compressed form. There is a fossa below and in front of the parapophysis, which continues to beyond the anterior dorsals. The dense layer of the surface of the centrum is smooth, except some delicate striations near the articular borders. These are most marked along the median inferior face of the caudal vertebræ, which is flat, grooved, and distally acute.

I cannot certainly connect the vertebræ of a series as those of a single individual.

*Measurements.*

	No. 1.	M.
Diameter of a cervical with hypapophysis	{ antero-posterior . . . . .	.023
	{ vertical . . . . .	.021
	{ transverse . . . . .	.020

	No. 2.	m.	
Diameter do. without hypapophysis	{	antero-posterior . . . . .	.017
		vertical . . . . .	.0165
		transverse . . . . .	.017
	No. 3.		
Diameter do. without hypapophysis	{	antero-posterior . . . . .	.011
		vertical . . . . .	.0105
		transverse . . . . .	.011
	No. 4.		
Diameter of an anterior dorsal	{	antero-posterior . . . . .	.023
		vertical . . . . .	.023
		transverse . . . . .	.023
	No. 5.		
Diameter of an anterior dorsal	{	antero-posterior . . . . .	.008
		vertical . . . . .	.0072
		transverse . . . . .	.0075
	No. 6.		
Diameter of a sacral centrum	{	antero-posterior . . . . .	.010
		vertical . . . . .	.009
		transverse . . . . .	.009
	No. 7.		
Diameter of an anterior caudal	{	antero-posterior . . . . .	.083
		vertical . . . . .	.053
		transverse . . . . .	.058
	No. 8.		
Diameter of a median caudal	{	antero-posterior . . . . .	.017
		vertical . . . . .	.011
		transverse . . . . .	.011
	No. 9.		
Diameter of a posterior caudal	{	antero-posterior . . . . .	.014
		vertical . . . . .	.0086
		transverse . . . . .	.007

A vertebra not distinguishable from the corresponding one of this species was found near Amell's Creek, on a bank of deposit of the Fox Hills group (No. 5), with the bones of the *Uronautes cetiformis*, supra. I cannot account for this circumstance, as it is the most abundant fossil of the Judith River beds (No. 6).

**Champsosaurus brevicollis, sp. nov.**

On one occasion the writer discovered a number of vertebrae of this genus close together, and in such relation as to induce the belief that some of them belonged to the same individual. Parts of several were obtained, however, adding another evidence of the

manner in which the fossils of this formation have been dislocated and scattered. The evidence for the existence of this species must be allowed to rest at present on a cervical vertebra, with free hypapophysis. This body differs from the corresponding one in the *C. annectens* in its greater brevity as compared with its length. The vertical and transverse diameters exceed the longitudinal in the *C. brevicollis*, while in the *C. annectens* the length exceeds both. The inferior aspect of this centrum is broadly rounded, not carinate as in *C. annectens*. The value of this character is uncertain, but a centrum similarly rounded below (above alluded to) has the more elongate form of the *C. annectens*.

		<i>Measurements.</i>	M.
Diameter of centrum	}	antero-posterior . . . . .	.013
		vertical . . . . .	.014
		transverse . . . . .	.015

*Champsosaurus vaccinsulensis*, sp. nov.

This reptile is indicated by a posterior dorsal vertebra in which the common base of the neural arch and diapophysis is decurved to below the middle of the side of the centrum. This surface has somewhat the outline of the section of a T-rail, the inner portion being on the superior face of the centrum. The centrum is shorter than the corresponding ones of the *C. annectens* and *C. profundus*, so that the basis of the neural arch approaches near the borders of the articular faces above. The centrum is perforated by two vertical foramina as in most *Sauropterygia*. The osseous tissue of the bone is quite dense, and the surface is smooth.

		<i>Measurements.</i>	M.
Diameter of centrum	}	antero-posterior . . . . .	.026
		vertical . . . . .	.029
		transverse . . . . .	.045

Besides the much larger size, this species differs from those previously referred to this genus in almost all details of proportion, etc.

**SCAPHERPETON**, Cope.

*Genus novum Batrachiarum.* Vertebrae deeply biconcave, with opposed, but not continuous, foramina for the chorda dorsalis. Neural arch with zygapophyses, and well-developed neural spine. Centrum with vertically compressed, short diapophysis

near the posterior extremity, a prominent hypapophysial keel, and prolonged neural spine. Supposed proximal limb bone with a branch-like trochanter. Supposed teeth in several rows, attached in shallow alveoli, those of the marginal series larger; the crowns obtusely conic and simple.

In the above diagnosis are expressed the general characters of a genus of probably tailed *Batrachia* which has left remains of several species in the Judith River beds of the Upper Missouri region. Although the vertebræ resemble no little those of *Clepsydrops*, Cope, a rhynchocephalian lizard from supposed triassic or permian formations, the atlas is that of a batrachian. The limb bone probably belonging to it, is unlike that of any genus of the *Proteida* or *Trachystomata*, differing also from that of *Menopoma*, but approaching nearly that of the typical salamanders. The diapophyses are different in form from those of the *Trachystomata* *Proteida* and *Amphiimidæ*, but resemble in their vertical compression those of *Menopoma*. They are generally broken in the specimens, but where preserved, are much shorter than in that genus, being even less produced than in most of the recent salamanders. The prominent keel of the median line below is not found in salamanders, and it has no posterior prolongation resembling the structure seen in *Amphiura* and *Cæciliidæ*. The produced neural spine is a character not found among tailed *Batrachia*, and the posterior direction which it takes reminds one of the *Dinosauria* more than anything else, and is not like the form seen in *Lacertilia*. It is a prolongation of the roof-like extension of the neural arch seen in some of the tertiary salamanders of France.

The structure of the proximal limb bone, and the form of the diapophyses of the vertebræ refer this genus with much probability to the *Urodela*. The produced neural arch, and the probably complex disposition of the teeth, indicate a family different from any of those now living. The biconcave centra place it nearest to the *Amblystomidæ*.

The teeth above mentioned are attached to a fragment of a jawbone. The crowns are all imperfect, and mostly broken off. There are three series of smaller teeth and a marginal series of teeth of one half greater diameter. They exhibit a moderate pulp cavity, and the superficial investment of the crowns is not inflected. It has a minute granular rugosity, and the bases of the teeth are rugose



with impressed punctæ. The teeth are described here because it is not known to which species they belong. It is, indeed, not certain, but only probable, that they belong to this genus.

Four atlases preserved indicate two species; one being more depressed than the other three, and the anterior cotyli therefore more transverse.

The vertebræ indicate four species. It is probable that they present some peculiarities at different points in the same column, the caudals at least differing in some degree from the others. The characters of the species are quite well marked.

*Scapherpeton tectum*, sp. nov.

Represented by a vertebra which is one of the best preserved in the collection. The most prominent specific character is seen in the entire roofing over of the neural canal between the anterior zygapophyses, and in the downward production of the inferior median line of the centrum, and accompanying downward prolongation of the articular cups. The chordal perforation is at the superior fourth of the vertical diameter of the cups. The neural spine is produced backwards and curved upwards, and is narrowed between the posterior zygapophyses, and is striate grooved on the under surface. About half of the posterior zygapophysis projects beyond the edge of the cup of the centrum. Immediately below the anterior edge of the posterior zygapophysis, the diapophysis begins. It is vertical, of an irregular figure 8 in section, and is directed outwards and backwards. A foramen passes under its middle, emerging a little before the middle of the same horizontal diameter of the centrum. It is joined by another which strikes it from below at right angles. There is a deep notch embraced between the superior part of the diapophysis and the posterior zygapophysis. The neural canal is wider than deep.

A fragment accompanied this vertebra when found, which resembles the articular portion of the mandible. There is no angle projecting behind the quadrate facet, which is oblique, truncating the extremity of the ramus. The lower edge is acute, behind roughened, and a thickening extends along the middle of the inner side of the ramus so far as preserved. The character is that of a Urodele Batrachian.

		<i>Measurements.</i>	M.
Diameter of centrum	{	antero-posterior . . . . .	.0875
		vertical . . . . .	.0750
		transverse . . . . .	.0500
Vertical diameter of diapophyses . . . . .			.0500
Transverse diameter of neural spine between posterior zygapophyses . . . . .			.0500
Depth mandibular ramus at front of quadrate cotylus . . . . .			.0800

*Scapherpeton laticolle*, sp. nov.

Vertebrae of several individuals of smaller size than those referred to the *S. tectum* differ in the less extensive development of the roof connecting the anterior zygapophyses, and the greater compression of the centrum, in consequence of the downward production of the inferior keel. The neural arch is openly notched between the anterior zygapophyses, but the notch is bounded by a recurved lamina distinct from the zygapophyses. The diapophyses are much as in *S. tectum*; the ridge from the inferior portion of it is quite prominent, and includes with the base of the neural arch a deep fossa.

Accompanying a dorsal vertebra like those of this species, and probably belonging to the same skeleton, is an atlas of a more depressed form than those presumably belonging to the other species. The median tuberosity is well developed, constricted at the base, and much flattened. The condyloid facets are narrow and transverse.

		<i>Measurements.</i>	M.
Diameter of dorsal centrum	{	antero-posterior . . . . .	.070
		vertical . . . . .	.050
		transverse . . . . .	.030
Width of the neural canal . . . . .			.020
Vertical diameter of base of diapophysis . . . . .			030

If it should appear that the dorsal vertebrae do not represent a species distinct from the *S. tectum*, the *S. laticolle* may rest on the atlas described.

The limb bone above mentioned is associated with the neural arch of a vertebra of the character ascribed to this species. Both extremities are eroded so as not to display the forms of the condyles, though almost the entire length is preserved. The trochanter is imperfect, but its base is that of a subcylindric process. The head of the bone is subtriangular, and the section of the

distal end an oval with a flat side. The diameter contracts gradually to the middle.

		<i>Measurements.</i>	M.
Length of bone	. . . . .		.0150
Diameter	{	proximally . . . . .	.0036
		medially . . . . .	.0019
		distally . . . . .	.0037

This bone is plainly that of a urodele salamander.

*Scapherpeton excisum*, sp. nov.

This salamander is represented in the collection of the expedition by vertebræ of three individuals of different sizes. They all agree in having the anterior zygapophyses separated by the concave excavation of the roof of the neural canal usual in ordinary salamanders, and in the moderate development of the hypapophysial keel. As a result, the articular extremities of the centra are not produced so far inferiorly as in *S. laticolle*. The longitudinal ridge from the inferior part of the diapophysis is pronounced, and separates a deep fossa above it from another below it. The longitudinal perforation of the base of the diapophysis issues in the superior fossa, while in the two smaller specimens a vertical perforation joins it from the inferior fossa. As in the preceding two species, one articular face is a little deeper than the other.

		<i>Measurements.</i>	M.
Diameter centrum No. 1	{	longitudinal . . . . .	.009
		vertical . . . . .	.006
		transverse . . . . .	.005
Width of neural canal do.	. . . . .		.003
Depth " "	. . . . .		.0015
Diameter centrum No. 2	{	longitudinal . . . . .	.0060
		vertical . . . . .	.0033
		transverse . . . . .	.0030

Specimen No. 1 is as large as the corresponding portion of an *Amphiuma means*.

*Scapherpeton favosum*, sp. nov.

The vertebra which I select as typical of this species is more distinct in character from those of the three species above described, than they are from each other. Although the centrum presents a strong inferior keel, its border is not horizontal or convex, but concave, and the articular cups are proportionally little elongated downwards. The diapophyses have at their bases a

relatively small vertical diameter, and the longitudinal perforation enters below and before the base and not behind it. The longitudinal ridge from the inferior part of the latter is very prominent and horizontal, bridging over the vertical perforation, which enters the superior lateral fossa. It is separated below from the posterior perforation by a short oblique bridge. The neural arch is lost from this specimen.

There are other vertebræ which display a slightly developed inferior keel, and articular cups little produced downwards, but the fossæ are less developed than in the one described.

		<i>Measurements.</i>	M.
Diameter of centrum	}	antero-posterior . . . . .	.006
		vertical . . . . .	.004
		transverse . . . . .	.003

The typical individual was about as large as the *Menopoma*.

#### HEMITRYPUS, Cope.

Represented by a vertebra of the general character of those of the genus *Scapherpeton*, but which lacks the foramen chordæ dorsalis of the posterior half of the centrum, and is not earinate on the inferior surface. The diapophysis is directed backwards just below the posterior zygapophysis, inclosing with it a notch into which the anterior zygapophysis is received. Anterior zygapophyses connected by a prolongation of the neural arch.

I had suspected that this vertebra might be one of those of the cervical region of a species of *Scapherpeton*, but the position of the foramen chordæ dorsalis renders this highly improbable. The only position to which it could be assigned in the column of this genus would be that of the axis. But the foramen is present in the posterior half of the atlas and thus probably in the axis in *Scapherpeton*, as in vertebræ from all other regions of the column, so that such an exception as is presented by the present centrum is not to be looked for. The absence of the carina, and the cylindrical form of the centrum, add to the belief that the species does not belong to *Scapherpeton*.

*Hemitrypus jordanianus*, Cope, sp. nov.

No emargination between the anterior zygapophyses; neural spine directed upwards and backwards. The diapophyses vertically compressed, directed downwards, inwards, and backwards,

and not giving origin to a strong ridge on the side of the centrum, as is seen in the species of *Scapherpeton*. Neither is there any fossa on the side of the centrum as in that genus. There is a small longitudinal foramen which enters the inner base of the inferior half of the diapophysis. There is a low ridge on each side of the neural arch, which extends backwards and inwards. The anterior articular face is a wide oval somewhat contracted below, and is pierced by a foramen at a point within the superior third of the vertical diameter. It is not so deeply excavated as in the species of *Scapherpeton*. The posterior articular face is a regular vertical oval, is concave, but not excavated, as is seen in the centrum of the genus just mentioned. The inferior face of the centrum is rounded, with some feeble lateral ridges.

	<i>Measurements.</i>	M.
Diameter of centrum	longitudinal . . . . .	.0070
	vertical . . . . .	.0050
	transverse . . . . .	.0040
Total elevation at middle . . . . .		.0090
Expanse of posterior zygapophyses . . . . .		.0070
“ “ “ diapophyses . . . . .		.0095

About the size of the *Menopoma allegheniense*.

This batrachian is dedicated to Prof. D. S. Jordan, of the Northwestern Christian University, author of the Manual of the *Vertebrata* of the Eastern United States.